Section II (Remarks)

Statement of Substance of June 23, 2008 Interview with United States Patent and Trademark Office Examiner Abul Kalam.

Appreciation is expressed to Examiner Abul Kalam for the courtesy extended in granting the undersigned attorney the interview conducted on June 23, 2008 with Examiner Kalam.

The substance of such interview is reflected in the following remarks, and in the substance of the Interview Summary issued by Examiner Kalam on July 3, 2008, in which Examiner Kalam stated that "Applicant's arguments with respect to the references was persuasive, and thus, the rejections of claims 31 – 38 and 41 – 52 will be withdrawn."

Petition for One-Month Extension of Time under 37 CFR 1.136

Petition hereby is made under the provisions of 37 CFR 1.136 for a one (1) month extension of the term for response set in the March 7, 2008 Office Action, to extend the deadline for response to such Office Action from a June 7, 2008 to July 7, 2008.

The fee of $120 sent out in 37 CFR 1.17(a)(1) for such extension of time is being paid by online credit card payment at the time of EFS submission of this response. Authorization also is hereby given to charge the amount of any additional fee or charge properly payable in connection with the filing and the entry of this response, to Deposit Account No. 08-3284 of Intellectual Property/Technology Law.

Addition of New Claims 53 – 55

New claims 53 – 55 have been added herein, to encompass a liquid crystal display aspect of the present invention. Such claims are fully consistent with and supported by the disclosure at page 22, lines 9-15 of the present application. Accordingly, no new matter within the meaning of 35 USC 132 is introduced by such new claims.

By such addition of new claims 70-72, and the cancellation herein of withdrawn, previously pending claims 1-17, 25-30, 39-42 and 53-69, no net addition has been made in the number of independent claims, or total claims. Accordingly, no added claims fee is due or payable.

As noted previously, authorization hereby is given to charge the amount of any deficiency in fees due and payable, to Deposit Account No. 08-3284 of Intellectual Property/Technology Law.

The newly added claims 70-72 were discussed with Examiner Kalam in the June 23, 2008 United States Patent and Trademark Office interview, and their basis of support in the disclosure of the application was indicated.

Rejections of Claims on Reference Grounds in the March 7, 2008 Office Action, and Traversal Thereof

In the March 7, 2008 Office Action, claims 31 – 38 and 43 – 52 were rejected on reference grounds, including:

(1) a rejection of claims 31 – 33, 35, 36, 44, 47 and 50 – 52 under 35 USC 103(a) as unpatentable over **Stevenson et al. US Patent 3,819,974** ("Stevenson") in view of **Pappalardo et al. US Patent 6,137,217** ("Pappalardo");

(2) a rejection of claims 34 and 49 under 35 USC 103(a) as unpatentable over **Stevenson and Pappalardo** as applied to claims 31 and 44, further in view of **Kitagawa et al. US Patent 5,237,182** ("Kitagawa");

(3) a rejection of claims 37 – 38 and 45 – 46 as unpatentable over **Stevenson and Pappalardo** as applied to claims 31 and 44, further in view of **Ditzik US Patent 5,771,039** ("Ditzik");

(4) a rejection of 43 and 48 under 35 USC 103(a) as unpatentable over **Stevenson and Pappalardo** as applied to claims 31 and 44, further in view of **alleged Applicants Admitted Prior Art** ("AAPA").

Such rejections are traversed, in light of the arguments set out below, which Examiner Kalam indicated in the June 23, 2008 interview acknowledged as persuasive, and correspondingly stated that "the rejections of claims 31 – 38 and 43 – 52 will be withdrawn."

Patentable Distinction of Claims 31 – 38 and 43 – 55 Over the Cited References.

(1) **Stevenson in view of Pappalardo** – Claims 31–33, 35, 36, 44, 47 and 50–52

Stevenson was cited in the March 7, 2008 Office Action as disclosing an LED emitting in "violet region" and down-converting phosphor producing "all the primary colors" (Office Action, p. 3). It was conceded, however, that

> "Stevenson does not explicitly disclose wherein the phosphors are combined in order to produce a white light output from the light emission device" (Office Action, p. 3)

Pappalardo was cited to fill in the gap ("Pappalardo teaches a light emission device wherein a luminophoric medium ('quad-phosphor blend,' col. 2: ln. 35) comprises a plurality of phosphors, which are combined to produce a white light output (abstract, col. 2: lns. 30-53)."

Pappalardo describes a fluorescent tube filled with Hg and inert gas to produce uv radiation excitation energy of Hg plasma.

The "quad blend" of Pappalardo relates to the use of 4 instead of 3 phosphors, for improved color rendering. The phosphors include:

- first and second red phosphors with different emission regions in the 590-630 nm range;
- a third blue phosphor with emission principally in the 430-490 range; and
- a fourth no-rare-earth green phosphor with emission principally in the 500-570 nm range.

The asserted basis for rejection of claims 31–33, 35, 36, 44, 47 and 50–52 is that "[I]t would have been obvious ... to incorporate the teaching of Pappalardo into the invention of Stevenson, to combine the phosphors used to produce the primary colors, for the disclosed purpose of generating a white light output with an enhanced color rendering index" (Office Action, p. 3).

Such rejection is made under 35 USC 103 (a), pursuant to which obviousness must be judged "at the time the invention was made."[1] Therefore, evidence of the state-of-the-art in the field of the invention, and the conventional prevailing wisdom in the field at that time, are probative of whether patentable invention exists.

At the time the applicants' claimed invention was made, the conventional wisdom in the LED art was embodied in the approach described in Stinson US Patent 4,992,704 issued February 12, 1991 (of record). Stinson discloses three-LED array lamps in which:

> "Each of the respective light dies is associated with a different primary color, such as red, green and blue. The control circuit attached to the leads may vary the color intensity of each of the light dies so that the overall and combined light radiating from the housing may be a predetermined color or hue. Therefore, any color, including the color white, can be produced from a single lamp 10."
>
> (Stinson US Patent 4,992,704, column 3, lines 36-42)

The present application acknowledges this state-of-the-art, at page 4, line 21 to page 5, line 2 therein:

> "U.S. Pat. No. 4,992,704 issued to Stinson teaches a variable color light emitting diode having a unitary housing of clear molded solid epoxy supporting three LED dies characterized as producing color hues of red, green and blue, respectively. There have been some recent introductions of commercial "full-color" LED lamps, that are essentially discrete lamps which afford a means of producing white light. All currently available examples of such lamps contain a minimum of three LED dies (or chips) - one red, one green and one blue, encapsulated in a single epoxy package."

The cited references of Stevenson and Pappalardo therefore are properly considered in the context of the three-LED (one red LED, one blue LED, one green LED) state-of-the-art approach for LED white light production at the time the applicants' claimed invention was made,

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[1] 35 U.S.C. 103 Conditions for patentability; non-obvious subject matter.
(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious *at the time the invention was made* to a person having ordinary skill in the art to which said subject matter pertains. (emphasis added)

in order to determine if Stevenson and Pappalardo in combination teach or suggest the applicants' claimed display.

The applicants' claimed invention as broadly recited in claims 31 and 44 requires, *inter alia*, a "display including at least one light emission device, wherein each light emission device comprises an LED energizable to emit radiation with an emission maximum in a spectral range of the blue to ultraviolet spectrum, and a luminophoric medium arranged to be impinged by radiation emitted from the LED and to responsively emit radiation in a range of wavelengths."

Stevenson discloses a gallium nitride LED producing violet light (column 1, lines 10-12 of Stevenson), and in columns 3-4 discloses that:

> "... there has been provided an improved light emitting diode capable of emitting light in the violet region of the spectrum. This device may be used as a source of violet light for applications where this spectral range is appropriate. This light maybe converted to lower frequencies (lower energy) with good conversion efficiency using organic and inorganic phosphors. Such a conversion is appropriate to develop different colors for aesthetic purposes, but also to produce light in a spectral range of greater sensitivity for the human eye. By use of different phosphors, **all the primary colors may be developed** from this same basic device. An **array of such devices may be used for color display systems**: for example, a solid state TV screen."

Stevenson thus explicitly teaches to use an LED/phosphor device to generate a primary color, and to use an array of such primary color-generating LED/phosphor devices for color displays.

Stevenson's teaching therefore mirrors the conventional wisdom of the approach of Stinson, to utilize a separate LED to produce each of red light, green light and blue light components.

Pappalardo fails to "fit" with this state-of-the-art approach of Stinson, reinforced by Stevenson, to utilize an array of LED devices, each of which produces a primary color (red, green and blue), to constitute an RGB array for display applications.

Pappalardo, in addition to being inconsistent with such RGB array approach, is directed to a fundamentally different illumination device, a fluorescent light tube generating a mercury plasma.

Further, Pappalardo is not directed to any display applications or display devices, but instead is directed to a lighting article conventionally used for lighting of interior spaces in homes and offices.

The motivation urged in the Office Action (page 3, last paragraph) is "to combine the phosphors used to produce the primary colors, for the disclosed purpose of generating a white light output with an enhanced color rendering index."

The only conceivable basis for such motivation resides in the existence of applicants' claimed invention, and not in any derivative basis in Stevenson and Pappalardo, since Stevenson can only be construed as a teaching to utilize an array of LED devices, each of which produces a primary color (red, green and blue), to constitute an RGB array for display applications.

The hypothesized combination, however, requires the deconstruction of a fluorescent tube lamp to extract the phosphor mixture component therefrom, and to import same into an LED/phosphor device of Stevenson, ignoring the fact that such reconstructive effort would destroy the functionality of Stevenson's LED/phosphor device, since it would no longer be able to generate a primary color for display purposes.

There is accordingly no derivative basis in the cited references of Stevenson and Pappalardo for the applicants' claimed display (independent claim 31) or apparatus comprising same (independent claim 44). As a result, independent claims 31 and 44, and claims 32-33, 35, 36, 47 and 50-52 variously dependent thereunder, are fully patentably distinguished over Stevenson in view of Pappalardo.

(2) **Stevenson in view of Pappalardo further in view of Kitagawa** – Claims 34 and 49

Kitagawa has been cited as disclosing an LED emitting in the blue to ultraviolet spectrum. Even if such Kitagawa LED were substituted into Stevenson, the same fatal deficiencies discussed above would obtain in the resulting reference combination of Stevenson in view of Pappalardo, in view of Kitagawa. The deficiencies of Stevenson in view of Pappalardo are numerous, and include:

the fact that Stevenson teaches to utilize a separate LED to produce each of red light, green light and blue light components;

the fact that Pappalardo fails to "fit" with this approach of Stevenson, to utilize an array of LED devices, each of which produces a primary color (red, green and blue), to constitute an RGB array for display applications;

the fact that Pappalardo, in addition to being inconsistent with such RGB array approach, is directed to a fundamentally different illumination device, a fluorescent light tube generating a mercury plasma;

the fact that Pappalardo is not directed to any display applications or display devices, but instead is directed to a lighting article conventionally used for lighting of interior spaces in homes and offices; and

the fact that the combination of Stevenson and Pappalardo requires the deconstruction of a fluorescent tube lamp to extract the phosphor mixture component therefrom, and to import same into an LED/phosphor device of Stevenson, ignoring the fact that such reconstructive effort would destroy the functionality of Stevenson's LED/phosphor device, since it would no longer be able to generate a primary color for display purposes.

These deficiencies are not overcome by substituting a Kitagawa LED into the Stevenson and Pappalardo hypothetical combination.

Accordingly, claim 34 and claim 49, depending from independent claims 31 and 44, respectively, likewise patentably differentiate over the reference combination of Stevenson and Pappalardo further in view of Kitagawa, for the same reasons noted in the preceding discussion for the patentability of independent claims 31 and 44.

(3) **Stevenson in view of Pappalardo, further in view of Ditzik** - claims 37 – 38 and 45 – 46

Ditzik in the rejection of claims 37-38 and 45-46 has been cited in combination with Stevenson and Pappalardo, on the basis that "Ditzik discloses that it is well-known to used [sic] LED light sources to provide uniform backlight to liquid crystal display panels." The asserted combination

therefore requires combination of Stevenson and Pappalardo, previously discussed, which has been clearly shown to fail to provide any basis for obviousness of applicants' claimed display (independent claim 31) and apparatus comprising same (independent claim 44).

In addition, Ditzik fails to disclose any LED/phosphor assemblies for backlighting, and the mere mention of LED light sources in Ditzik therefore can only be understood as a suggestion to add primary color (red, blue, green) arrays of LEDs, as a conventional RGB array structure, since no specific LED structures or arrangements are described in or derivable from Ditzik.

Accordingly, the hypothesized utilization of a Stevenson/Pappalardo device for the backlighting application of Ditzik fails to provide any *prima facie* basis for the rejection of claims 37-38 (dependent from claim 31) or for the rejection of claims 45-46 (dependent from claim 44).

(4) **Stevenson and Pappalardo, further in view of alleged Applicants Admitted Prior Art ("AAPA")** - claims 43 and 48

The rejection of claims 43 and 48 are based on the Stevenson/Pappalardo combination, further in view of alleged admitted prior art. The alleged admitted subject matter is the description at pages 11-12 of the present application of material emitting at least in the green, yellow spectrum (Office Action, p. 7).

Taken in the context of the Stevenson/Pappalardo combination, as failing to provide any derivative basis for independent claims 31 and 44 (see discussion, *supra*), the mere existence of a green, yellow emitter fails to provide any basis for altering the Stevenson teaching to use an LED/phosphor device to generate a primary color, and to use an array of such primary color-generating LED/phosphor devices for color displays, other than to use such a green emitter in a Stevenson LED/phosphor as a green light device component of a 3-LED RGB array. This reference combination therefore leads back to the same 3-LED RGB array approach previously discussed, and fails to provide any basis for applicants' claimed display (claim 43, dependent from claim 31) or display apparatus (claim 48, dependent from claim 44).

The claims 31-38 and 43-52 therefore are patentably delineated over the art, and allowable.

Patentable Distinction of Added Claims 70-72

New claims 70-72, directed to liquid crystal displays comprising back light structure including LED/phosphor assemblies, are likewise patentably demarcated over the about-discussed references cited in the March 7, 2008 Office Action, for corresponding reasons to those advanced above in support of the patentability of claims 31-38 and 43-55. No such LCD display is disclosed in or derivable from the cited references.

Further, it was not apparent, *a priori*, at the time of making of the present invention, that LED/phosphor assemblies would or could be bright enough for liquid crystal display (LCD) backlighting applications, or that such assemblies would or could provide the spectral matching and homogeneity required for backlighting of LCD displays.

Claims 70-72 therefore recite patentable subject matter.

Secondary Evidence of Patentability of Claims 31 – 38, 43 – 55 and 70-72

Set out below is a discussion of secondary evidence probative of patentability of the claimed invention, which was discussed with Examiner Kalam in the June 23, 2008 USPTO interview.

Appended as Exhibit A of this response is a copy of a copyright 1996 information release of Fraunhofer-Gesellschaft (http://www.thg.de/press/md-e/md1997/197), of record in the present application, and published after applicants' invention had been made, stating that "[S]ingle white LEDs were not feasible to date" and that "[T]he mixture of colors making up white light was only possible with a combination of three different diodes." This information release goes on to publicize Fraunhofer-Gesellschaft's "innovative idea ... the generation of white light by luminescence conversion" of an LED/luminescent dye assembly, as a "breakthrough." This information release, reflecting subsequent discovery by Fraunhofer-Gesellschaft, is highly probative evidence of the innovative and patentable character of applicants' presently claimed invention.

Further evidence is provided in Exhibit B hereof, which is a copy of an additional information release, Fraunhofer-Gesellschaft: Research News Special 1997, published at http://www.fhg.de/press/md-e/md1997/sondert2.htm, which states that:

> "Red, yellow, and yellowgreenish [sic] emitting LEDs have already been on the market for a long time, while blue and green emitting LEDs became commercially available only three years ago. By combining red, green, and blue emitting diodes, the generation of white light became possible. However, the emission of white light by a single chip LED was still impossible.
>
> This problem was solved by a research team at the Fraunhofer-Institut fur Angewandte Festkorperphysik IAF in Freiberg (Germany) and, at the same time, by their colleagues at Nichia Chemical Industries in Japan. Their innovative idea was to generate white light by luminescence conversion. They combined a blue emitting GaN LED with an organic dye or an inorganic phosphor, emitting at longer wavelengths, to synthesise white light by additive colour mixing. ....For the invention of the single chip white emitting LED the research team at the IAF was awarded the 1997 Fraunhofer Prize."

This information release, also of record in the present application and published after applicants' invention had been made, and likewise reflecting subsequent discovery by Fraunhofer-Gesellschaft and Nichia, is additional highly probative evidence of the innovative and patentable character of applicants' presently claimed invention.

CONCLUSION

For all the foregoing reasons, claims 31-38, 43 to 55 and 70-72 are now in form and condition for allowance.

This response reflects the substance of the discussion with Examiner Kalam at the June 23, 2008 United States Patent and Trademark Office interview. Arguments have been presented clearly showing the patentable distinction of the pending claims over the cited references. Further, secondary evidence of patentability of the claimed invention has been presented herein, with reference to the appended Exhibit A and Exhibit B documents.

The examiner's acknowledgement of the foregoing arguments as "persuasive" and "thus, the rejections of claims 31 – 38 and 43 – 52 will be withdrawn" (Interview Summary mailed July 3, 2008) is acknowledged with appreciation.

Favorable action is correspondingly requested.

Respectfully submitted,

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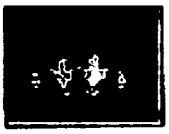
Exhibit A

Topic 1
Dazzling white LEDs



The best products, especially those for everyday use, are small, robust, long-lived and highly efficient. Conventional light bulbs have failed to meet these requirements - being fragile, short-lived, and inefficient. The brighter energy-saving bulbs, however, are oversized and their waste disposal is problematic. Now a new type of white light emitting diode is setting out to conquer the market for illumination.
Light-emitting diodes or LEDs do not contain glowing filaments, since semiconductors convert electrical current directly into light. We encounter LEDs everywhere, for example as yellow, green or red displays in instrument panels. They are long-lived and so especially advantageous, wherever it would be expensive or troublesome to replace short-lived light bulbs regularly.
Single white LEDs were not feasible to date, as they emit monochromatic light only. The mixture of colours making up white light was only possible with a combination of three different diodes. Researchers at the Fraunhofer-Institut für Angewandte Festkörperphysik IAF (Fraunhofer Institute for Applied Solid State Physics) have achieved a breakthrough. The innovative idea was the generation of white light by luminescence conversion. Blue emitting diodes based on gallium nitride were combined with luminescent dyes giving bright light emission at changed wavelengths. The resulting mixture of colours is visible as white light. Furthermore, these LUCOLEDs - luminescence conversion LEDs - allow light emission in a wide colour range, depending on the emission of the dyes used. In addition to white light, arbitrary colour tones of the spectrum are possible, e.g. purple.
The innovative, simple, and inexpensive manufacture of the diodes are excellently suited for large volume production. Siemens will introduce the first white LUCOLEDs commercially next year.

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Exhibit B

Topic 2
White light from a single LED

In contrast to the fragile and shortlived light bulb, light-emitting diodes, or for short LEDs, are small, robust and highly efficient. LEDs are based on semiconductor chips which convert an electric current directly into light. A current of a few milliamps is sufficient to generate light resulting in a low power consumption. LEDs are cheap and have a lifetime of about 100,000 hours, or i.e. they emit light at a constant intensity for 11 years when operated 24 hours a day. Because of these advantages they have already found many applications in, e.g., traffic lights, dashboards and as indicator lights in consumer electronics wherever replacement is cumbersome and expensive. Red, yellow, and yellowgreenish emitting LEDs have already been on the market for a long time, while blue and green emitting LEDs became commercially available only three years ago. By combining red, green, and blue emitting diodes, the generation of white light by LEDs became possible. However, the emission of white light by a single chip LED was still impossible.

This problem was solved by a research team at the Fraunhofer-Institut für Angewandte Festkörperphysik IAF in Freiburg (Germany) and, at the same time, by their colleagues at Nichia Chemical Industries in Japan. Their innovative idea was to generate white light by luminescence conversion. They combined a blue emitting GaN LED with an organic dye or an inorganic phosphor, emitting at longer wavelengths, to synthesise white light by additive colour mixing. Peter Schlotter, a member of the IAF research team, points out a further advantage of the new luminescence conversion LEDs (LUCOLEDs): "LUCOLEDs allow to extend the range of colours emitted by LEDs to whatever colour is required, depending on which conversion dyes or phosphors are used. Even purple light, which is impossible to be generated by conventional LEDs, can be emitted by LUCOLEDs." For the invention of the single chip white emitting LED the research team at the IAF was awarded the 1997 Fraunhofer Prize.

This simple but innovative and lowcost process, developed in close cooperation with Siemens AG, will enable mass production of white emitting LEDs. Siemens plans to start up production of white single chip LEDs in 1998.

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